The Minnesota Agricultural Experiment Station:

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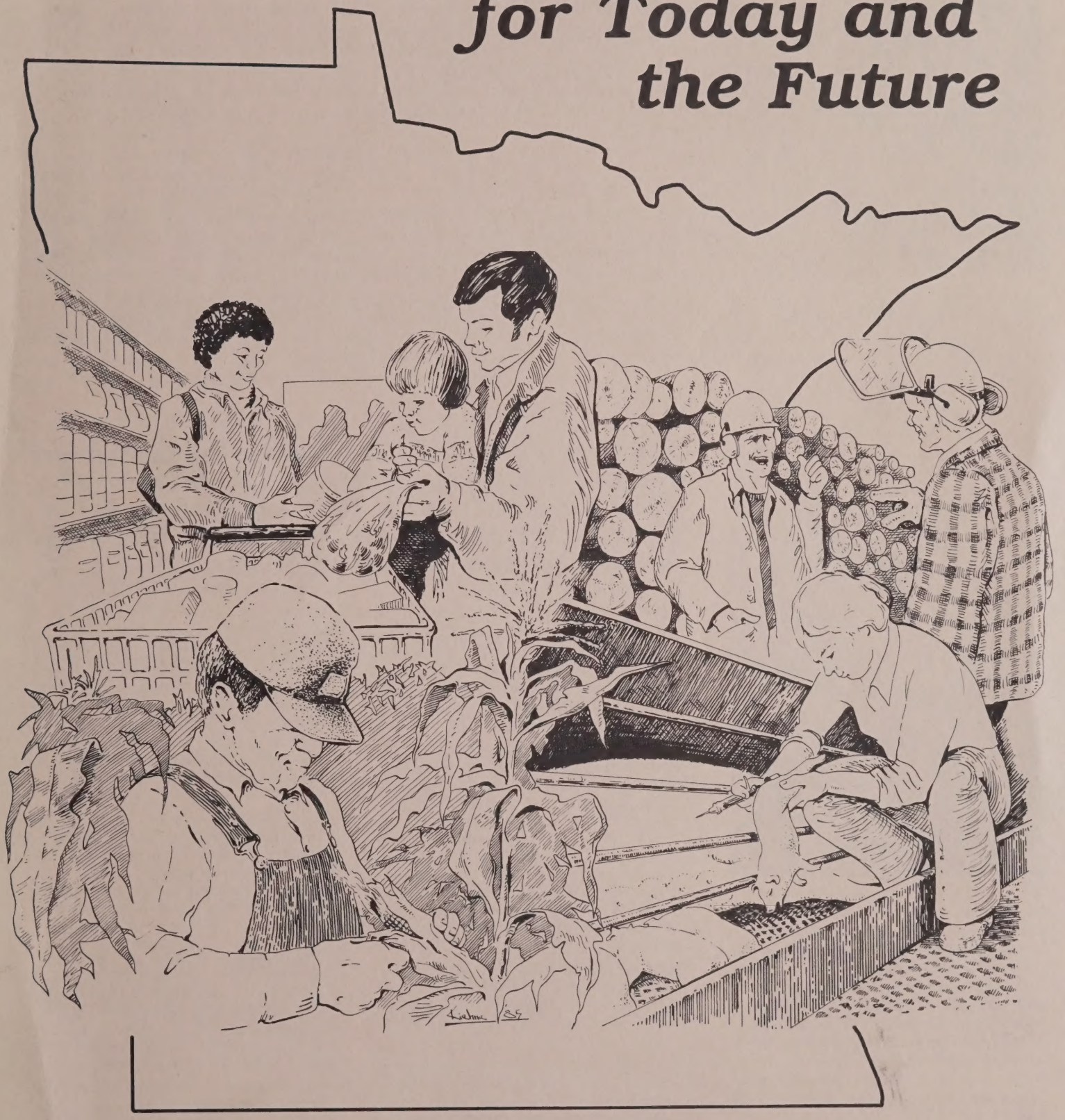
A Proven Investment for Today and the Future



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BOOKSTACKS

For the past 100 years, Minnesotans have invested in their and future generations' welfare by funding the research of the Minnesota Agricultural Experiment Station.

Established by the state legislature in 1885, the Station organizes and supports research on the production, processing, marketing, distribution, and quality of food and other agricultural products. Other Station research seeks to improve forests and forest products, public policy, human nutrition, family and community life, recreation and tourism, and overall environmental quality in Minnesota.

Faculty from the University of Minnesota's Colleges of Agriculture, Forestry, Home Economics, Veterinary Medicine, and Biological Sciences conduct most of the Agricultural Experiment Station's research. The research is conducted on the university's St. Paul campus and at Rosemount; at branch experiment stations at Crookston, Grand Rapids, Lamberton, Morris, and Waseca and at other University of Minnesota research facilities; and on private and state-owned lands throughout Minnesota.

The people of Minnesota provide, in the form of appropriations from the state legislature, almost 62% of the resources for Station research. Federal funds make up another 13%, and income from the sale of by-products of the Station's animal and crop research provides 7%. Gifts and grants account for the remaining 18%.

Research is a gamble because it involves a probing into the unknown. Sometimes, it results in no payoff or benefits. Sometimes, it is of value only because it shows that something does not work. Sometimes, the payoff from research is modest. At other times, however, the returns are large—even phenomenal—worth many times the original investment. In some instances, the benefits of research, although apparent, cannot be measured in dollars. The following are a few of the many ways that dollars invested in Minnesota Agricultural Experiment Station research has resulted in a better life for all Minnesotans.

Station plant breeders began to develop rust-resistant cereals soon after plant pathologist E. C. Stakman found in 1918 that the stem rust fungus had 6 races. Plant pathologists in the Cereal Rust Lab monitor rust populations, and plant breeders use their findings to develop cereals resistant to prevalent races. As a result, Station-developed wheat varieties have not been damaged by rust since 1954.

Research organized and supported by the Station has paid handsome dividends to farmers, helping to keep agriculture No. 1 among Minnesota's industries and assuring high-quality, reasonably priced food for all Minnesota consumers.

1900—Dairy scientist T. Haecker writes a bulletin on feeding standards for cattle. This was the first attempt to establish scientifically based feeding standards in the United States, and it remained the bible on feeding dairy cattle until 1940.

1936—Dairy scientist C. L. Cole obtains the first birth of a calf through artificial insemination (AI). Adoption of AI has hastened genetic progress because of more intensive use of quality sires. In Minnesota, this has allowed average annual milk production per cow to increase from 4,400 pounds in 1940 to 12,139 pounds in 1984. This represents about $900 more income per cow annually.

1940—Poultry scientist T. Canfield develops a method determining the sex of day-old chicks, poults, and goslings that saved the poultry industry $250 million in 1984.

Animal scientist L. M. Winters introduces crossbreeding concepts into commercial pork production that saved producers $80 million in 1984.

1946—J. E. Lambert begins the Station's soybean breeding program at a time when only 452,000 acres of soybeans were grown in Minnesota. In 1984, Minnesota farmers grew 5.8 million acres of soybeans. The improved varieties developed by the Station have contributed many millions of dollars to soybean producers' income over the years.

1957—The Station releases Park Kentucky bluegrass. Park, which continues to be an important variety, provided the basis for establishing the grass seed industry in northwestern Minnesota.

1960—Animal scientist R. M. Jordan begins work on the development of milk replacer formulas and lamb management schemes that have enabled Minnesota producers to reduce lamb mortality 40 to 50%, increasing their income over $2 million annually.

1965—Animal scientists J. C. Meiske and R. D. Goodrich show that feed costs can be reduced more than $1 per 100

pounds of gain by feeding feedlot calves whole, instead of processed, corn. For the 500,000 cattle fed each year in Minnesota to a gain of 500 pounds, savings of more than $2.5 million result.

1966—Dairy and veterinary scientists conduct research on using post-milking teat dips to control mastitis, the most costly disease in dairy cattle. This new management approach reduced new mastitis incidence by 50%, and saves Minnesota farmers $10 million yearly in otherwise lost milk production.

1968—Animal scientist W. J. Boylan introduces Finn sheep to the United States. Finn breeding has increased the average lambing rate in Minnesota about 20%, providing extra lambs worth $2.4 million annually.

1970—Station scientists initiate research that over the next decade produced results that caused Minnesota corn producers to plant 10 days earlier than previously and to increase plant populations by 2,000 plants per acre. These changes have increased Minnesota's corn production each year by 56 million bushels and corn producers' income by $140 million.

The Station releases Era wheat. Minnesota producers have grown Era on more than 20 million acres since its release, earning $280 million more than they would have if they'd grown the varieties it replaced. In 1982, the Station released Marshall wheat, now the most widely grown variety in Minnesota and North Dakota.

1971—Animal scientist R. Meade develops simple pig starters that allowed producers to save $1 per pig in feed costs. By using these starters, producers saved $8 million in feed costs in 1984.

1972—Animal scientist E. F. Graham develops an extender for turkey semen that allows producers to produce hatching eggs via artificial insemination with only one-sixth as many toms as before. In 1984, use of the extender saved producers $13 million.

1973—Agricultural engineer C. Larson develops a computer model for predicting water infiltration for any rainfall or sprinkler irrigation pattern. The model has been used to design center pivot irrigation systems, and to study ground water recharge, moisture availability for corn, tillage's effect on soil moisture, and drainage projects' effects on watershed runoff.

1974—Scientists at the Northwest Experiment Station develop a method of preserving cull potatoes and potato processing wastes by ensiling them with forage. Previously, these by-products were discarded in dumps and landfills. Wastes from Minnesota potato processing plants are worth $6 million annually as animal feed.

Farmers tour corn research plots during a 1948 field day at the West Central Experiment Station, Morris. In 1930, the Station released parental lines for 3 double-cross field corn hybrids, which set in motion a rapid changeover from open-pollinated varieties. Since then, releases of improved inbred lines have increased yields by 1 bushel per acre per year and reduced lodging by 1% per year. Inbred line A632 performed so well in hybrid combinations that it was used in 1975 to produce enough hybrid seed to plant 15.2% of the total U.S. corn acreage.

1975—Oat smut is epidemic in Minnesota, reducing yields in many fields by 50 to 60%. This led plant pathologist R. D. Wilcoxson to cooperate with oat breeders to develop the resistant varieties Noble, Lyon, Moore, Benson, and Preston.

1976—Animal scientist D. Otterby develops storage and feeding systems that allow farmers to use colostrum and waste milk instead of expensive milk replacers to grow calves. In 1984, this research saved Minnesota dairy farmers $2.4 million in calf losses and $2.4 million in feed expenses.

1977—Soil scientist R. H. Rust initiates an accelerated soil survey program. Goal is to have a modern survey of every county by 1992, from which crop management, drainage design, tax assessment, waste disposal and many other land use decisions can be made. Potential payoffs from better land use and the protection of the soil, Minnesota's most basic resource, are enormous.

W. Wallingford finds that small grains mature and yield satisfactorily on organic soils if copper is applied to the soil. The added cropping option affected nearly all of Minnesota's 7 million acres of organic soils.

1978—The Station releases Morex barley, which rapidly became the standard for malting quality and the most widely grown malting variety in the United States. Minnesota farmers have grown Morex on over 3 million acres since 1978, earning over $54 million more than they would have had they grown the varieties it replaced. In 1983, the Station released Robust, which is expected to replace Morex as Minnesota's No. 1 barley variety in 1985.

Agricultural engineers H. Cloud, R. V. Morey, and J. Gustafson develop combination and natural air corn drying processes that reduce energy use and improve grain quality, saving Minnesota farmers more than $5 million yearly.

The Station releases McCall soybean. This high-yielding, early-maturing variety is one of the main reasons for the recent large increase in soybean acreage in northern Minnesota, where it has contributed significantly to the diversification of agriculture.

1979—The Station releases Sweet Sixteen, Keepsake, and State Fair, the most recent in a series of 22 apple introductions. Cultivars introduced by the Station account for over 60% of Minnesota's apple production, with an annual market value of $6 million.

Agricultural economist W. B. Sundquist begins research on the payoff from public sector agricultural research. His conclusion: research in the North Central Region for corn, wheat, and soybeans produced returns exceeding 50 percent per year.

Forestry scientist H. Scholten begins research to find shrubs that can be used for windbreaks under center-pivot irrigation systems to protect the topsoil and reduce damage to young crops. Four suitable species have been identified to date.

1980—Climatologists M. Seeley and D. G. Baker begin weekly agriculture weather advisories that help Minnesota farmers make important management decisions, saving them an estimated $4 million per year because of reduced weather damage to crops.

Agricultural engineers R. Gustafson and H. Cloud and animal scientist R. Appleman conduct research into the causes, detection and solution proce-

dures, and animal sensitivity factors related to stray voltage problems in livestock facilities. This research, and research done cooperatively with University of Minnesota psychologists, electrical engineers, and veterinary scientists, has made the university the leader in understanding and solving stray voltage problems.

1981—Plant pathologists and agricultural economists cooperate to make the first economic analysis of crop loss due to ozone in the atmosphere. Results of this study are basic to the development of state and federal regulations on air pollution.

Entomologists E. B. Radcliffe and D. M. Noetzel demonstrate that the Colorado potato beetle and sunflower beetle can be controlled with dosages of insecticides much lower than label recommendations. Use of these low doses saves Minnesota growers about $4 million per year.

Agricultural engineer D. W. Bates and veterinary scientist J. Anderson establish demonstration complete health programs for 5 dairy herds. By providing separate maternity quarters and improving housing design, milk production in these herds has increased more than 1,000 pounds per cow, and calf mortality has been reduced from 10 to 40% to about 1%.

Soil scientist J. Moncrief expands research and education programs in conservation tillage. Acres cropped with conservation tillage in Minnesota increased from 43,500 in 1980 to 168,000 in 1984. When managed properly, corn and soybean yields will equal or exceed those from conventional tillage, yet save Minnesota farmers $3 million yearly.

1982—Floriculturist R. E. Widmer develops a system to shorten production time of flowering cyclamen pot plants by 40%. This may save Minnesota greenhouse growers as much as $75,000 and allow them to grow 25-30% more plants each year.

Research begins at the West Central Experiment Station using thin stillage (a by-product of ethanol production from corn) in lieu of water and supplemental nitrogen for finishing steers. Animal scientists H. E. Hanke, R. D. Goodrich, J. C. Meiske and L. Lindor found that steers fed thin stillage had 5% less feed costs and grew 5% faster. Utilization of thin stillage eliminates the pollution hazard and returns about 40% of the cost of fermentation, making farm-size ethanol plants economically feasible.

Agricultural engineers R. V. Morey and C. Schertz begin work on a system for collecting, transporting, processing and burning corncobs to dry shelled corn. The system offers potential to significantly reduce the amount of fossil fuels used to dry corn in Minnesota.

1983—Based on research at the Northwest Experiment Station, scientists suggest a 25-pound reduction in the per-acre nitrogen recommendation for sugarbeets. The reduction improves processing quality, and along with reduced fertilizer costs, potentially increases return by $18 million annually in Minnesota.

The Station releases Northblue and Northsky blueberries. It's expected that these hardy cultivars and others under development will enable Minnesota growers to produce the 10 million pounds of blueberries currently supplied by out-of-state growers. In 10 to 15 years, Minnesota's blueberry crop could be worth $8-10 million.

Several Station research projects have looked at lighting's effect on turkeys. In 1958, poultry scientist R. Shoffner and co-workers developed a blueprint for a light management system that resulted in year-round, rather than seasonal, egg production. This has been worth about $200 million to producers over the years.

1984—Plant pathologists N. A. Anderson and E. B. Banttari develop and maintain pathogen-free seed potato stocks that yield 15-25% more than certified seed and give Minnesota growers the opportunity to increase yields substantially.

Molecular biologist J. Messing does research on the analysis and manipulation of Zein storage proteins in corn. U.S. farmers might save annually as much as $400 million in the production of hogs and $250 million in the production of poultry if this research results in the development of commercial corn hybrids with higher nutritional value.

A 3-year effort to expand high-value vegetable production in Minnesota ends. During that time, asparagus acreage increased over 1,000 acres, with crowns available to plant 1,500 acres more in 1985. Broccoli and cauliflower acreage increased from fewer than 50 acres to about 350 acres. The commercial value of production from 1,000 acres of asparagus is about $1.7 million yearly; the 1984 broccoli and cauliflower acreage represents $900,000 in new income.

1985—High-protein Proat oats, the seventeenth oat variety developed by Station scientists, is released. Among the varieties released by the Station is Moore, currently the most widely grown oat in Minnesota. These releases have helped keep Minnesota among the top oat-producing states.

Station research has helped Minnesota's agriculturally related industries to grow and remain competitive.

1972—Food scientist L. L. McKay begins research on the genetics of starter cultures. The first to use recombinant DNA techniques to improve such cultures, McKay had, by 1984, successfully induced bacteria to take up DNA directly from the surrounding medium. As a result of his research, improvements have been made in the cultures used to make cheese, yogurt and other fermented food products.

1975—Food scientist S. Tatini develops a quick and simple test that detects the presence of Staphylococcus enterotoxin in foods. The test is used by food industry and regulatory personnel for routine quality control aimed at preventing food-borne illness.

1979—Agricultural engineer D. Thompson and food scientists F. Busta and C. E. Allen develop a model for predict-

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ing the safety of slow cooking beef. Previous safety estimates based on the destruction of dangerous organisms were inadequate. Slow-cooked rare beef accounted for $136,000 of Minnesota beef processors' business in 1984.

1982—Agricultural engineer J. Strait's research results in installation of a continuous-flow wild rice parcher in a processing plant. The prototype uses about half as much fuel as conventional parchers and could save a typical plant about $16,000 yearly in fuel costs as well as significant labor costs.

1984—Plant pathologist R. Brambl develops a process to measure contamination of foods and grains by storage molds. The extremely sensitive and accurate process should reduce or prevent economic losses to the grain industry and food manufacturers.

Agricultural engineer D. Thompson defines the minimum blanching conditions for commercial canning and freezing of vegetables. His work shows that many Minnesota processors can reduce blanch treatments, thereby increasing plant capacity, reducing waste material, and increasing the quantity of finished product per unit of raw vegetable.

Forest scientists A. Alm (left) and R. Dixon examine containerized tree seedlings. Use of containerized seedlings became operational in 1978 because of Alm's research. In 1984, 6 million greenhouse-grown seedlings were produced and planted in Minnesota. These will have an unprocessed value of $5.6 million when mature, and harvesting and transporting to a mill will increase their value at least threefold.

Research by Minnesota Agricultural Experiment Station scientists has helped Minnesota's forest industries to grow and remain productive, and it has helped protect and improve the state's environment.

1901—H. H. Chapman initiates reforestation experiments at the North Central Experiment Station. This research, although conducted at a time when lumber was plentiful, demonstrated the need for continuous regeneration of Minnesota's forest resources.

1952—Plant pathologists D. W. French and C. M. Christensen begin research to determine the cause of paper machine felt deterioration. By 1960, they had developed techniques that greatly increased the life of felts on paper machines, saving the industry millions of dollars.

1958—Wildlife researcher G. Gullion begins studies that ultimately provide the most complete body of information on ruffed grouse biology and result in management strategies used throughout North America.

1960—Plant pathologists D. W. French and F. Baker and forest scientists F. Irwing and M. Meyer develop nonchemical management strategies to control dwarf mistletoe in black spruce, Minnesota's most valuable pulpwood species. In 1982, plant pathologist R. Blanchette and horticultural scientists M. Brenner and W. Livingston found that mistletoe could be controlled with sprays of ethylene-releasing agents, an environmentally safe procedure that could substantially reduce the $300-400 million annual loss mistletoe causes the forest industry.

1971—Forest products researchers R. Gertjejansen and J. Haygreen develop technology making it possible to use a blend of dense hardwoods and aspen in particleboard/waferboard. Based on their findings, Minnesota's wood panel industry began to use dense hardwoods in the early 1980s, expanding significantly the raw material base and the potential for industrial expansion in the state.

1977—Wildlife researcher L. D. Frenzel, his students, and U.S. Forest Service biologists develop a management strategy for bald eagles that is helping this endangered species recover.

1980—Animal scientist E. F. Graham adapts techniques used with livestock for the successful cryopreservation of fish eggs and sperm. The techniques will be valuable in developing selective breeding programs that will enhance fisheries management and be the basis for a burgeoning aquaculture industry in Minnesota.

1981—Minnesota Tree Improvement Cooperative is formed. The co-op uses materials and information generated by Station research to genetically improve forest tree seedlings. It is estimated that, by 2000, almost half of the 20 million seedlings planted in Minnesota each year will be grown from improved seed. Growth rates of improved stock should be 5-20% above those of stock now used.

1982—Plant pathologists E. Schmidt and D. French develop a methyl bromide treatment for eradication of oak wilt fungus from logs. The process finds immediate commercial application and eliminates a pending European embargo on U. S. oak veneer log shipments valued at $100 million annually.

Forest products scientist J. Haygreen publishes his findings on the mechanics of compression drying wood. By 1984, a prototype press for compression drying of wood chips was in service. Potential annual savings are $9-10 million in Minnesota industries that generate energy from wood.

1983—Team research led by D. Rose produces a regional timber supply model for assessing opportunities for industrial expansion. The model allows assessment of costs for transporting harvested timber by road or rail from any location in Minnesota to processing facilities.

1984—Tree physiologist R. Dixon introduces a system for innoculating red and jack pine and white spruce seedlings with mycorrhizal fungi to increase seedling survival and growth. Routine use of this technology could reduce replanting costs $20-50 an acre on the 50,000 acres reforested in Minnesota each year.

Forest scientist L. Merriam and an assistant study campsites in the

Boundary Water Canoe Area to identify and assess changes resulting from their use. The study culminates 18 years of research on visitor impacts and provides a basis for developing new management plans for this world-renowned tourist attraction.

Forest scientists D. P. Guertin and K. N. Brooks develop a model that predicts changes in water yield and flooding associated with peatland development. By helping in the evaluation of schemes to develop peatland for energy and horticultural purposes, the model will help ensure that minimal adverse hydrologic impacts occur.

And, Station research has done much to improve the quality of life for Minnesota's families.

1944—Plant pathologist C. M. Christensen announces that strains of the *Penicillium* fungus that were developed by his lab are being released for commercial penicillin production.

1972—Textile scientist S. Davison publishes findings on problems in laundering white wash in hard water areas of Minnesota. Her findings result in recommendations for improving family maintenance of clothing and textiles throughout hard water areas of the Midwest.

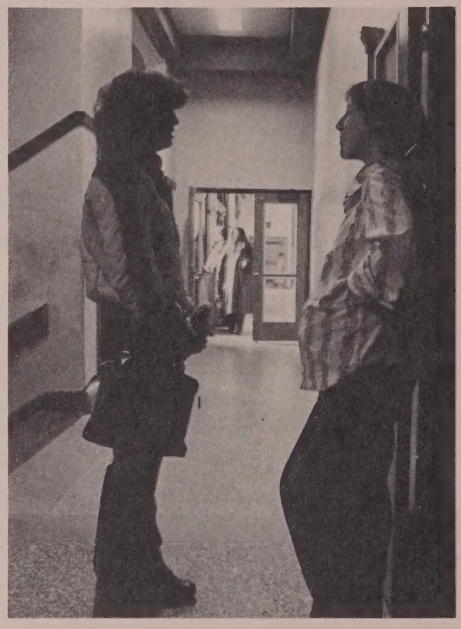
1973—Home economist M. Grindereng introduces the results of research on welfare recipients' clothing problems and needs. The results have helped welfare departments evaluate budget standards against the needs of specific client groups. Benefits, incalculable in dollar and health terms, accrued to both the State of Minnesota and 126,000 individual clients.

1975—The Minnesota Legislature passes a camping tent and sleeping bag safety statute based on the textile product fire research of textile scientist R. Johnson. The bill has helped reduce camper injuries.

1976—Youth development researcher M. Baizerman begins research on adolescent female prostitution in St. Paul and on services for adolescent prostitutes and their families. In 1985, Baizerman developed a handbook for designing a community-based program to control and prevent adolescent prostitution.

1978—The Station introduces Northern Lights hybrid azaleas, which with the azalea clones it has introduced since then, represent a major breakthrough for improving the beauty of the landscape in northern areas. Although annual nursery production of these introductions is worth $.5 to $1 million, their major value lies in increasing real estate values.

1979—Social scientist D. Olson develops PREPARE, a test for couples contemplating marriage, that predicts divorce risk with 87% accuracy. By 1985, about 10,000 clergy had used the test with 50,000 couples, and 10% of these couples had decided not to marry.



Youth's views on teenage pregnancy and parenthood is one of the topics adolescence researcher D. Hedin has studied since beginning the Minnesota Youth Poll in 1977. Findings from this on-going study of teenagers' opinions and concerns are used to make public policy, formulate laws that affect youth, and develop school curricula. The studies have spawned a variety of projects, including a privately funded career program for at-risk girls.

1981—Food scientist H. Morris and dental microbiologist C. Schachtele discover that some aged cheeses have the ability to repress tooth decay. Research is begun to determine how they do this, and to isolate and identify the compound(s) involved.

Biochemist I. Liener develops a drug delivery system that prevents experimentally induced emphysema in hamsters. The technique may someday be used to stop the development of emphysema in humans, particularly cigarette smokers.

1983—Housing researcher C. Cook initiates study of the housing needs and opportunities of rural families headed by women. The research will identify housing concerns and issues needing public policy attention and provide tools for assisting the almost 30,000 Minnesota families of this type.

Nutritionist D. A. Savaiano and VA Hospital co-workers prove that yogurt microorganisms aid in the digestion of lactose and allow milk-intolerant people to benefit from the nutrition of dairy products. This finding could increase consumption of dairy products in parts of the world where intolerance of the lactose in milk is widespread.

Rural sociologists G. Donohue and R. Cantrell find that yoking (having a pastor serve more than one parish) reduces yoked congregations' community involvement because the pastor's role in each congregation is curtailed. They also found that this may be overcome through activities that increase lay involvement.

1984—Family social scientist H. McCubbin and a health scientist study families and adolescent risk behaviors with the cooperation of a health maintenance organization. Based on the findings, family-oriented programs aimed at preventing smoking and alcohol and drug use among adolescent family members have been developed in Minnesota.

Youth development researcher M. Baizerman is principal author of a manual published by the U.S. Government to help fire departments plan and implement programs for adolescent firesetters. Workshops on using the manual have been held for fire professionals from throughout Minnesota.

Family social scientist P. Rosenblatt documents tensions and stresses of family businesses in Minnesota. His findings, that the two systems—family and business—compete for resources and operate with different goals and values, are being used by Extension workers and others to help families.

The University of Minnesota, including the Agricultural Experiment Station, is committed to the policy that all persons shall have equal access to its programs, facilities, and employment without regard to race, religion, color, sex, national origin, handicap, age, or veteran status.